PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : F16C 25/06 — A1

(11) International Publication Number: WO 96/30662

(43) International Publication Date: 3 October 1996 (03.10.96)

(21) International Application Number: PCT/SE96/00362

(22) International Filing Date: 22 March 1996 (22.03.96)

(30) Priority Data:
9501179-7 31 March 1995 (31.03.95) SE

(71) Applicant (*for all designated States except US*): AKTIEBOLAGET SKF (publ) [SE/SE]; S-415 50 Göteborg (SE).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): KELLSTRÖM, Magnus [SE/SE]; Ensittarevägen 30, S-433 41 Partille (SE). KULLIN, Jonas [SE/SE]; Bårekulla 563, S-438 91 Landvetter (SE).

(74) Agent: SKF GROUP HEADQUARTERS; Innovation & Patents, S-415 50 Göteborg (SE).

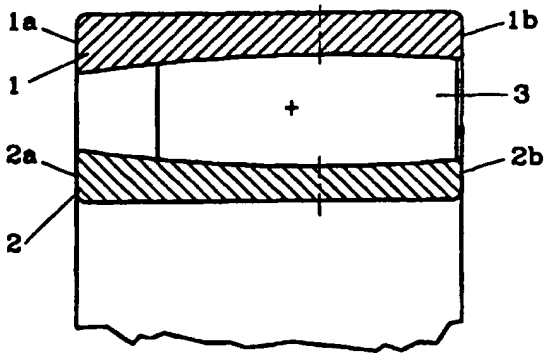
(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

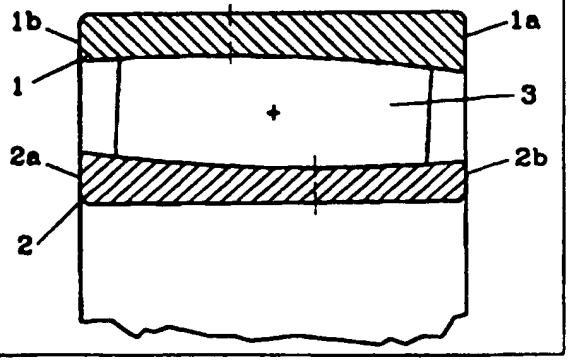
Published
With international search report.
With amended claims.

(54) Title: METHOD FOR CLEARANCE ADJUSTMENT IN A ROLLING BEARING

(57) Abstract

Method for clearance adjustment in a rolling bearing of the type incorporating a number of rollers (3) provided between and in contact with two race tracks, said rollers and race tracks having longitudinal section profiles of the same radii of curvature, said rollers (3) being axially moveable between the race tracks without being hindered by axial limitations at the race tracks, in order to allow relative misalignment and axial displaceability of the race tracks, the adjustment being achieved by actively displacing the inner and outer race rings (1, 2) of the bearing axially relative to each other.





FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgystan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic			SE	Sweden
CG	Congo	KR	Republic of Korea	SG	Singapore
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LR	Liberia	SZ	Swaziland
CS	Czechoslovakia	LT	Lithuania	TD	Chad
CZ	Czech Republic	LU	Luxembourg	TG	Togo
DE	Germany	LV	Latvia	TJ	Tajikistan
DK	Denmark	MC	Monaco	TT	Trinidad and Tobago
EE	Estonia	MD	Republic of Moldova	UA	Ukraine
ES	Spain	MG	Madagascar	UG	Uganda
FI	Finland	ML	Mali	US	United States of America
FR	France	MN	Mongolia	UZ	Uzbekistan
GA	Gabon	MR	Mauritania	VN	Viet Nam

METHOD FOR CLEARANCE ADJUSTMENT IN A ROLLING BEARING

The present invention refers to a method for clearance adjustment in a rolling bearing having an angle of contact close to 0°, and of the type incorporating a number of rollers provided between and in contact with two race tracks, said rollers and race tracks having longitudinal section profiles of essentially the same radii of curvature, said rollers thereby being axially movable along the race tracks without being hindred by axial limitations at the race tracks, in order to allow relative misalignment and axial displaceability of the race tracks.

The method can be applied to any adjustable bearings having a contact angle of or close to 0°, e.g. to spherical roller bearings, but it is particularly favourable at bearings where the radius of curvature of the longitudinal section profiles of said roller and race track is bigger than the distance between the outer race track and and the axis of the bearing, as measured perpendicularly to the race track.
The contact angle at bearings of the last-mentioned type is altered to such a small extent as compared to spherical bearings when subjected to axial adjustment that the axial load component is not worth mentioning.

Bearings of the last-mentioned type are known e.g. from EP-B1-0175858, and they combine different advantages from other types of bearings, such as axial freedom as a cylindrical roller bearing, self alignment as a spherical roller bearing and low section height as a needle roller bearing.

The life and stiffness of a bearing is extensively dependent on the radial internal clearance of the bearing, and it therefore is desirable to optimize the internal clearance for obtaining an optimized life and stiffness.

Conventional rolling bearings are generally delivered with different internal clearances, which is dependent of the specific application for which the bearing is intended . With

regard to the field of application it is necessary for the bearing to have either a positive or negative operational clearance, which in some instances is achieved during mounting, e.g. for angular contact bearings and taper roller bearings. It is also possible to provide bearings with specially made bearing rings, which during manufacture are matched to produce a predetermined positive or negative clearance or preload value after mounting. This of course means that an extensive number of different bearings with different internal clearance must be kept in stock.

The purpose of the present invention is to provide a method for clearance adjustment at bearings of the type referred to manufactured to have a reduced number of internal clearances, by which method it is possible to obtain an extensive range of clearance classes with efficient and simple steps, thereby reducing the requirement of keeping a big stock of bearings having different predetermined internal clearance.

In a bearing of the type now referred to, this adjustment of the operational clearance is achieved according to the present invention by actively displacing the inner and outer race rings axially relative to each other.

In a first embodiment of the invention one of the race rings of the bearing is manufactured with its centre displaced from the central position at half the distance between the ends of the rings. When such an unsymmetrical race ring in a first relation is displaced axially in one direction, the clearance is altered either to become greater or smaller, and by turning said one ring in reversed direction, the same direction of axial displacement will result in the same clearance adjustment but in reversed order, i.e. instead of becoming greater, the clearance will become smaller and vice versa. The same effect of course could be achieved by turning around the entire bearing at mounting, but this is not possible in cases where e.g. the inner race ring has a taper bore.

In another embodiment according to the invention both race rings of the bearing are manufactured with their centres displaced from the central position at half the distance between the ends of the rings. When mounting such a ring in a first relation the clearance can be big, and by turning one of said rings in reverse direction it is possible to obtain another, much smaller clearance, whereby the single bearing by means of a simple turning around of one ring at assembly can cover two different clearance classes.

According to a further embodiment of the invention such axial displacement can be further achieved by using separate spacer washers, which are positioned against the end face of one of the rings. By moving at least one such spacer washer to the opposite end face of the same race ring it is further possible to adjust the bearing clearance to cover two different clearance classes.

According to a still another embodiment of the application it is possible to use split bearing housings having a bearing seat disposed in a non-centered position in the removable half of the bearing housing. By positioning the removable bearing housing half in oppositely reversed directions the bearing received in the bearing housing can be given two different internal clearances. In this case it is of course necessary that opposite half of the bearing housing has a free adjustment space for the axially movable bearing ring.

Furthermore it is possible to combine the first embodiment as mentioned hereabove with anyone of the second and third embodiments as mentioned, thereby making it possible to achieve up to eight different clearances in a single bearing, when using e.g. the spacing washers according to the second embodiment on both race rings.

In still another embodiment it is possible cause an incremental displacement of one of the race rings by providing said race ring with a guiding means extending helically along the envelope surface of the race ring opposed to the race

track in the ring, providing means projecting from a fixed position in the confronting surface of the bearing housing or the shaft and arranged to engage said guiding means, rotating said race ring relative to said housing and/or shaft, thereby causing axial displacement of the race ring, as a result of cooperation between said helical guiding means and said projecting means.

Hereinafter the invention will be further illustrated with reference to the accompanying drawings, showing schematically the different embodiments of the invention.

Fig. 1 illustrates a bearing of the type concerned and having one race ring with displaced centre,
Fig. 2a illustrates a bearing of the type concerned wherein both race rings have displaced centres,
Fig. 2b shows the bearing according to Fig. 2a wherein the inner race ring has been turned around in opposite axial direction.
Fig.s 3a and 3b illustrate use of spacing washers at opposite side faces of the outer race ring.
Fig.s 4a and 4b show the upper, removable half of a split bearing housing having the removable bearing house half provided with a non-centered bearing seat, the removable bearing house half being turned around in opposite axial direction in Fig. 4b as compared to the position of Fig. 4a.
Fig. 5 illustrates in a section through a bearing housing a preferred arrangement for axial adjustment and arresting of the outer race ring in the housing.

In Fig. 1 is schematically illustrated a roller bearing of the type referred to in the preamble. The bearing comprises an outer race ring 1 having an inner race track, an inner race ring 2 having an outer race track and rollers 3 disposed between said outer and inner race tracks. The curvatures of the race tracks and of the rollers are substantially equal and have a radius R, which in the embodiment illustrated is substantially bigger than the mean radius of the bearing.

The centre of the outer race ring 1 in this embodiment is displaced axially thus that it is situated offset from the geometrical center of the ring, resulting in an unsymmetric ring. The outer race ring 1 thus has side faces 1a and 1b of different heights.

With this embodiment of the invention it is possible to compensate for expansion, whereby displacement when the rings are arranged in the relation shown in Fig. 1 will give a certain compensation in one direction, whereas a simple turning around of the outer race ring 1, thus that side face 1a and side face 1b change place, will result in a possibility of obtaining a compensation of equal size, but in the opposite direction.

In Fig. 2a and 2b is schematically illustrated another embodiment according to the invention, wherein the centres of both race rings 1, 2 are displaced axially thus that they are situated offset from the geometrical centers of the rings, resulting in unsymmetric rings. The outer race ring 1 thus has end faces 1a and 1b and the inner race ring 2 side faces 2a and 2b of different heights. With this embodiment of the invention it is possible to alter the internal clearance of the bearing by turning one of the rings in opposite axial direction. In this manner it is achieved a possibility to allow a single bearing to cover two different clearance classes, i.e. when the bearing race rings are positioned with their resp. centres aligned.

When the outer race ring 1 is positioned in one axial direction, having its higher section end face 1a turned in one axial direction as in Fig. 2a, the bearing has its greatest internal radial clearance, whereas it when the outer race ring is turned 180° with its bigger end face section in the opposite axial direction such as shown in Fig. 2b, the clearance is at its smallest.

In another embodiment shown in Fig. 3a and 3b there is used a separate spacer washer 4, which by being positioned against either axial end face of the race ring can adjust the mutual

axial relation between the race rings thus that different, predetermined clearances can be obtained by shifting the washer 4 from one side to the other. Although shown only at the outer race ring, similar clearance adjustment effects may be obtained by positioning a washer at the inner race ring.

In still another embodiment illustrated in Fig. 4a and 4b a similar axial displacement between the race rings and thereby an adjustment of the internal clearance can be obtained by using a split bearing housing, where the removable housing half 5 has a non-centred bearing seat 6 in which the outer race ring 1 is received. By turning the removable bearing housing half 5 in opposite axial directions it is possible to make the same type of clearance adjustments as in the embodiments previously shown and described.

As stated above it is also possible to combine e.g. the embodiments according to Fig. 2 and 3 or Fig. 2 and 4, thereby making it possible to obtain a larger number of clearance adjustment positions.

In Fig. 5 is illustrated an outer race ring 1 of a bearing inserted with loose fit in a schematically illustrated bearing housing 5', and supporting a shaft 7. The outer envelope surface of the outer race ring 1 is provided with a guide means in the form of a helical groove 8, which is arranged to cooperate with a means projecting from the housing in the form of a set screw 10. This set screw 10 engages in the helical groove 8 and causes the outer race ring 1 to move axially, if the race ring is rotated relative to the housing, thereby causing adjusting of the internal clearance of the bearing in a simple manner. For arresting the race ring in a desired position, there is provided in the bottom of the helical groove a series of spaced apart indentations 9 or the like. By tightening the set screw 10 its tip can be caused to engage one of these indentations 9, thereby arresting the race ring in a position resulting in a desired internal clearance. For facilitating of the rotation of the outer race ring 1 relative to the housing 5',

the side face of the ring 1 may be recessed 11 for engagement with a tool for rotating the ring.

Although the drawings and the description have referred to one type of bearing, the method according to the invention can be used for different self-aligning bearings having contact angles close to 0°, as mentioned above. The invention is neither limited to the embodiments shown and described but can be varied and modified within the scope of the accompanying drawings. It thus is possible to provide the guiding means in the inner envelope surface of the inner race ring, and using a projecting means in form of a projecting nib fitted to the shaft and cooperating with said guiding means for effecting axial displacement of the inner race ring.

CLAIMS

1. Method for clearance adjustment in an adjustable rolling bearing having an angle of contact close to 0°, and of the type incorporating a number of rollers (3) provided between and in contact with two race tracks (1,2), said rollers and race tracks having longitudinal section profiles of the same radii (R) of curvature, said rollers thereby being axially moveable between the race tracks without being hindred by axial limitations at the race tracks, in order to allow relative misalignment and axial displaceability of the race tracks,
c h a r a c t e r i z e d t h e r e i n
that the adjustment is achieved by actively displacing the inner and outer race rings (1, 2) axially relative to each other.

2. A method as claimed in claim 1,
c h a r a c t e r i z e d t h e r e i n,
that it is applied on a bearing wherein the radius (R) of curvature of the longitudinal section profiles of said roller (3) and race track is bigger than the distance between the outer race track and the axis of the bearing (A), as measured perpendicularly to the race track.

3. A method as claimed in claim 1 or 2,
c h a r a c t e r i z e d t h e r e i n,
that the mutual displacing of the race rings (1, 2) is achieved in using one bearing race ring manufactured with its centre displaced from a position halfway between the ends of the rings, and mounting such ring in either of a first relation and a second relation, in which latter said one race ring is mounted in reversed axial direction, allowing a single bearing to cover a clearance having a positive or negative direction, resp. thereby obtaining compensation for axial expansion.

4. A method as claimed in claim 1 or 2,
c h a r a c t e r i z e d t h e r e i n,
that the mutual displacing of the race rings (1, 2) is achieved in using at least one bearing race ring manufactured with its centre displaced from a position halfway between the ends of the rings, and mounting such ring in either of a first relation and a second relation, in which latter said one at least one of the race rings is mounted in reversed axial direction, allowing a single bearing to cover two different clearance classes.

5. A method as claimed in claim 4,
c h a r a c t e r i z e d t h e r e i n,
that further mutual displacement of the race rings (1, 2) is achieved in using at least one removable spacer washer (4) and mounting said spacer washer against either of one end face of one of the race rings, and the opposite end face of the same race ring, thereby adjusting the bearing clearance to cover several different clearance classes.

6. A method as claimed in claim 1 or 2,
c h a r a c t e r i z e d t h e r e i n,
that the mutual displacement of the race rings (1, 2) is achieved in using a split bearing housing (5) having a bearing seat (6) disposed in a non-centered position in the removable half of the bearing housing, and positioning the removable bearing housing half in either of a first position with a first axial direction and a second position having an oppositely reversed axial direction, thereby adjusting the bearing received in the bearing housing to two different internal clearances.

7. A method as claimed in claim 6,
c h a r a c t e r i z e d i n,
incorporating the further features of claim 5.

8. A method as claimed in anyone of the preceding claims,
c h a r a c t e r i z e d i n,
providing one race ring (1) of the bearing with a guiding

means (8) extending helically along the envelope surface of the race ring opposed to the race track in the ring, providing means (10) projecting from a fixed position in the confronting surface of the bearing housing (5') or the shaft and arranged to engage said guiding means (8),
rotating said race ring (1) relative to said housing (5') and/or shaft,
thereby causing axial displacement of the race ring, as a result of cooperation between said helical guiding means (8) and said projecting means (10).

9. A method as claimed in claim 8,
c h a r a c t e r i z e d i n
providing arresting means (9) in connection to said guiding means (8) for causing arresting of said race ring (1) in different mutual positions between said guiding means (8) and said projecting means (10).

10. A method as claimed in claim 9,
c h a r a c t e r i z e d i n
using a series of spaced indentations (9) provided in the bottom of the helical groove (8) for arresting the race ring (1) in different axial positions in relation to the confronting surface of housing and/or shaft, by causing said projecting means (10) to project into one of said indentations (9).

11. A method as claimed in claim 8,
c h a r a c t e r i z e d i n
using a helical groove (8) as guiding means, and a set screw (10) extending through a wall of the bearing housing (5') as said projecting means.

12. A method as claimed in anyone of claims 8 to 10,
c h a r a c t e r i z e d i n
providing the guiding means in the inner envelope surface of the inner race ring, and using a projecting means in form of a projecting nib fitted to the shaft and cooperating with said guiding means for effecting axial displacement of the inner race ring.

AMENDED CLAIMS

[received by the International Bureau on 25 July 1996 (25.07.96); original claims 1-3 amended; remaining claims unchanged (1 page)]

1. Method for clearance adjustment in an adjustable rolling bearing having an angle of contact close to 0°, and of the type incorporating a number of rollers (3) provided between and in contact with two race tracks (1,2), each being made in one piece, said rollers and race tracks having longitudinal section profiles of the same radii (R) of curvature, said rollers thereby being axially moveable between the race tracks without being hindred by axial limitations at the race tracks, in order to allow relative misalignment and axial displaceability of the race tracks,

characterized therein

that the adjustment is achieved by actively displacing the inner and outer race rings (1, 2) axially relative to each other.

2. A method as claimed in claim 1,

characterized therein,

that it is applied on a bearing wherein the radius (R) of curvature of the longitudinal section profiles of said roller (3) and race track is bigger than the distance between the outer race track and the axis of the bearing (A), as measured perpendicularly to the race track.

3. A method as claimed in claim 1 or 2,

characterized therein,

that the mutual displacing of the race rings (1, 2) is achieved in using one bearing race ring manufactured with its centre displaced from a position halfway between the ends of the rings, and mounting such ring in either of a first relation and a second relation, in which latter said one race ring is mounted in reversed axial direction, allowing a single bearing to provide compensation for axial expansion with positive or negative direction.

FIG. 1

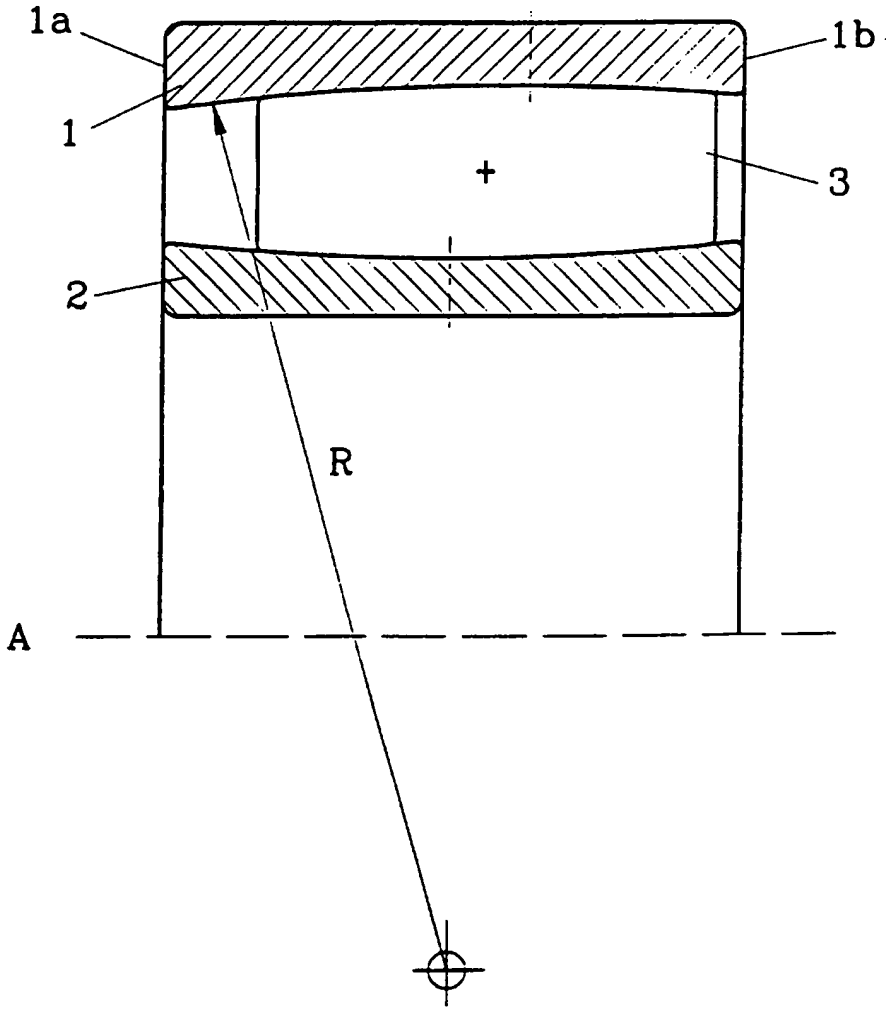


FIG.2a

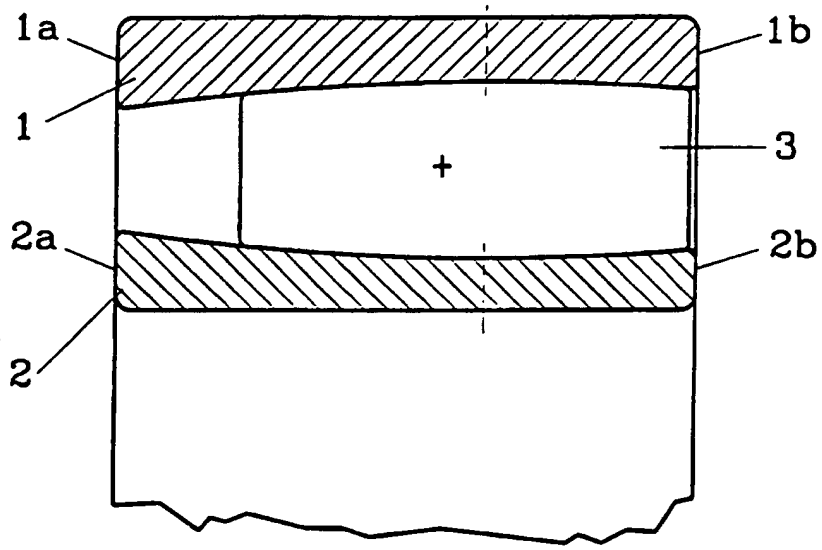


FIG.2b

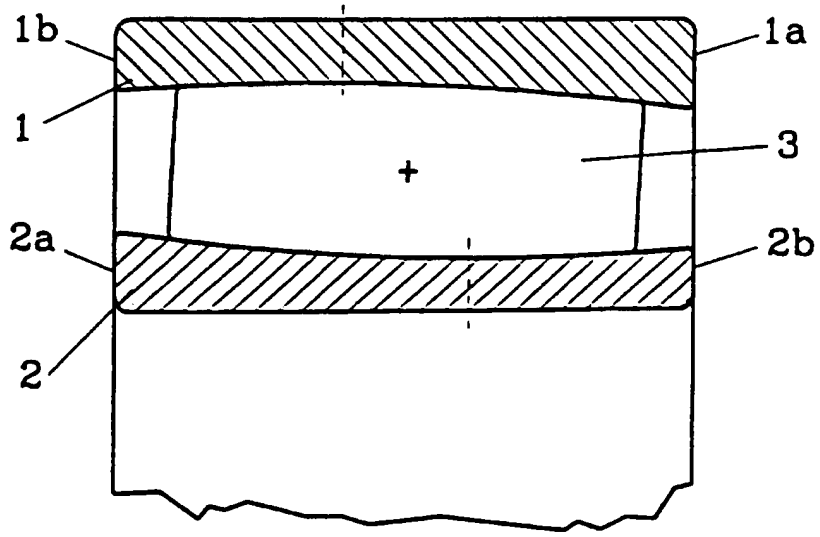


FIG.3a

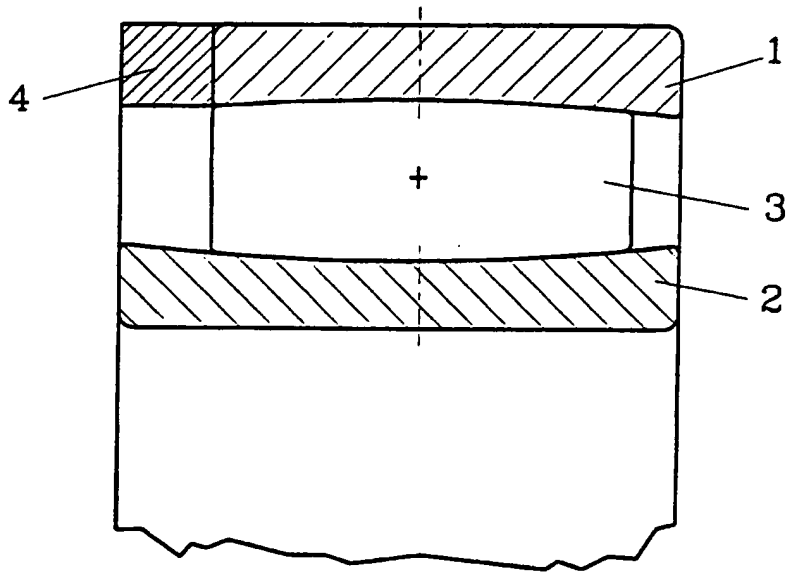


FIG.3b

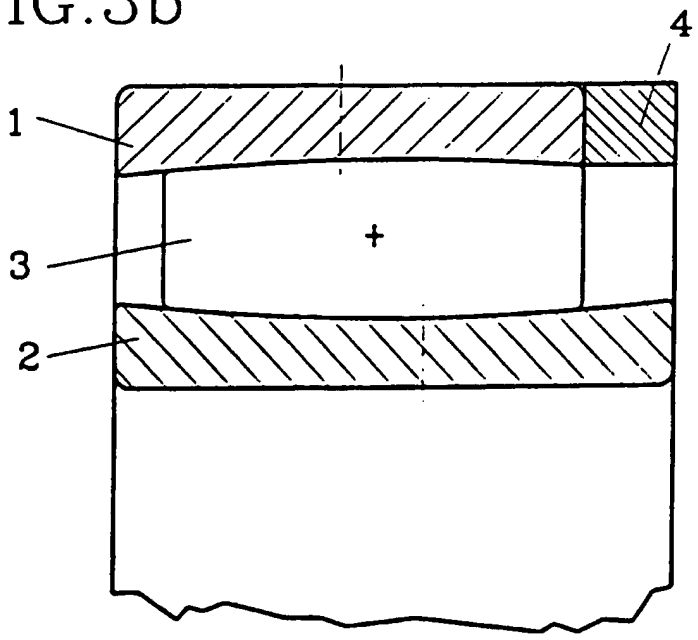


FIG.4a

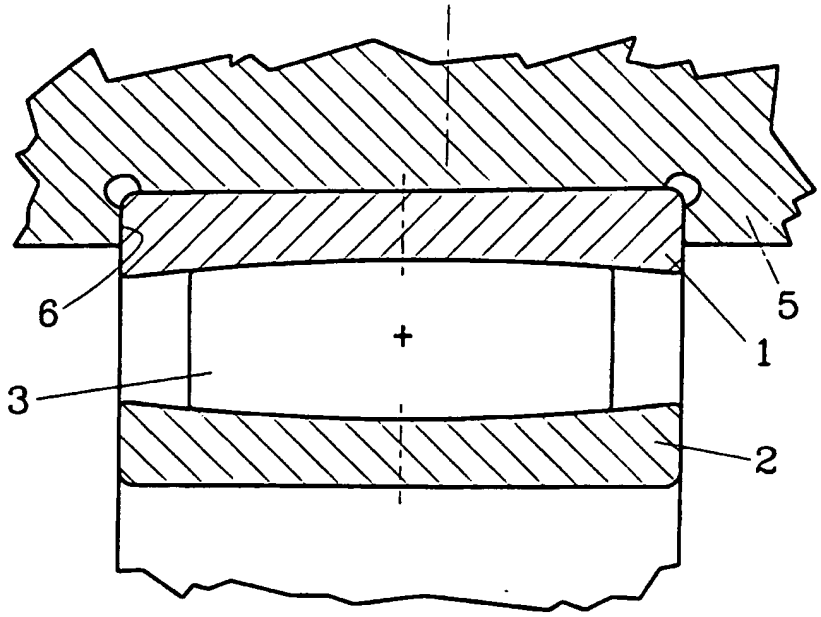


FIG.4b

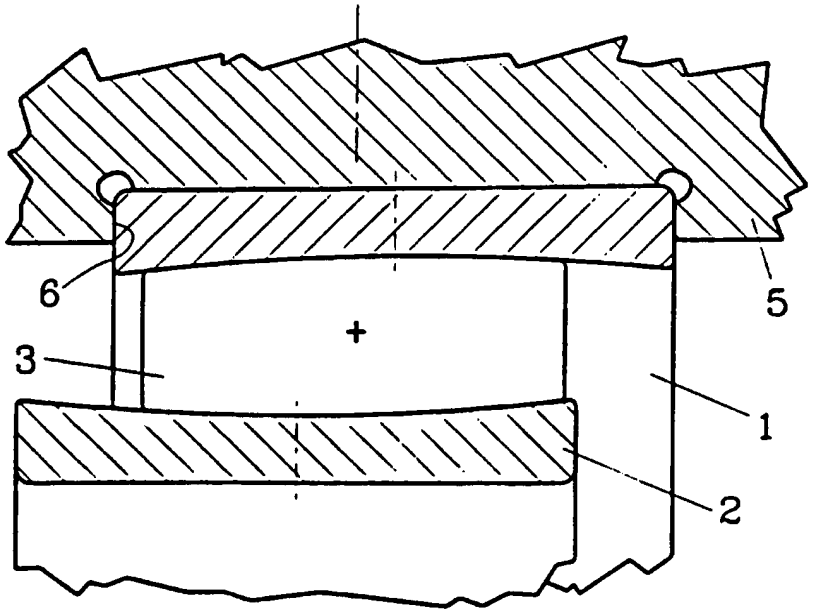
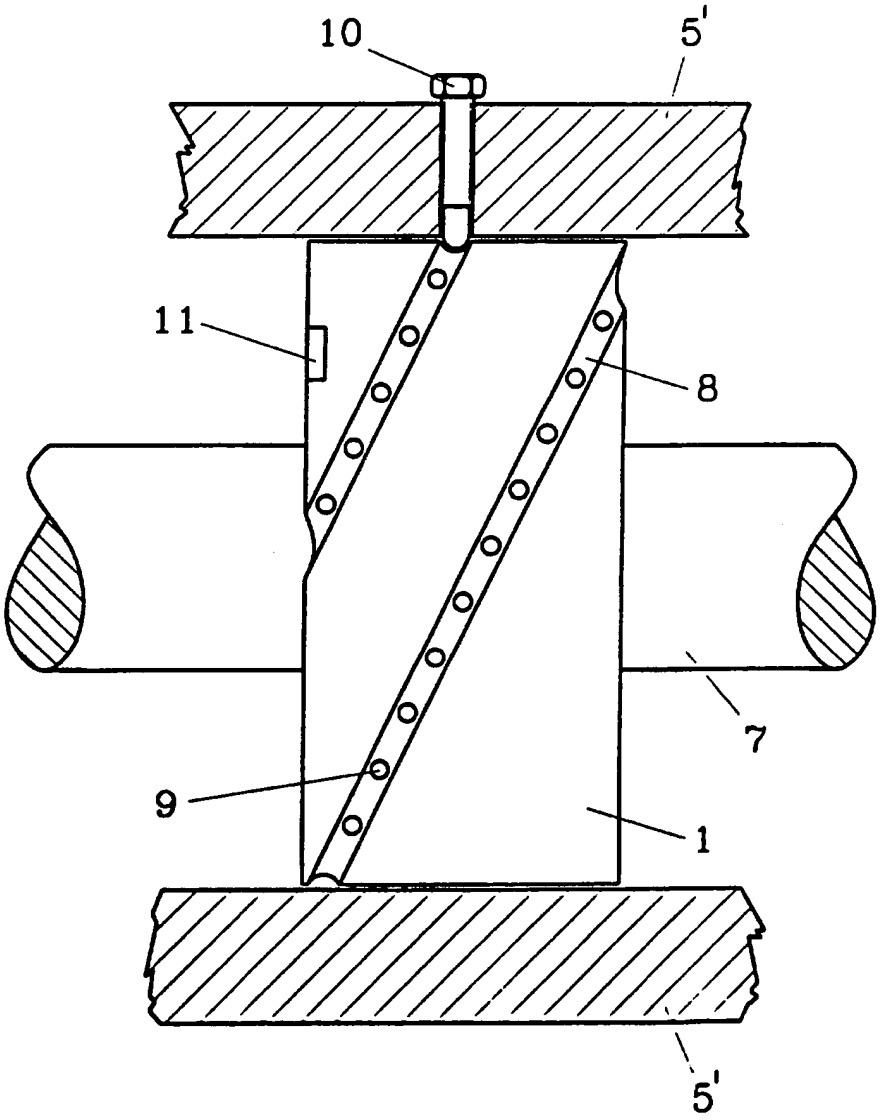


FIG.5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 96/00362

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F16C 25/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F16C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3306687 A (R.J. SMITH), 28 February 1967 (28.02.67), column 5, line 55 - line 65, figure 9	1,2
	--	
X	US 1280664 A (HERBERT C. CLARK), 8 October 1918 (08.10.18), page 1, line 61 - line 65, figure 5	1,2
	--	
A	SE 449908 B (AB SKF), 25 May 1987 (25.05.87)	1,2
	--	
A	CH 606844 A (ALFREDEEN PRODUCTION AB), 15 November 1978 (15.11.78)	
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 May 1996	29 -05- 1996

Name and mailing address of the ISA/	Authorized officer
Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Hans Hagström Telephone No. + 46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 96/00362

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CH 356319 A (FRANTISEK BOHÁCEK), 29 Sept 1961 (29.09.61) --	3
A	Patent Abstracts of Japan, Vol 11,No 135, M-585, abstract of JP, A, 61-274116 (TOSHIBA CORP), 4 December 1986 (04.12.86) --	
A	FR 423231 A (M. ALBERT-PAUL JAPY), 11 April 1911 (11.04.11) --	
A	US 3370900 A (S. MESSERSCHMIDT), 27 February 1968 (27.02.68) --	

INTERNATIONAL SEARCH REPORT

01/04/96

International application No.
PCT/SE 96/00362

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3306687	28/02/67	NONE	
US-A- 1280664	08/10/18	NONE	
SE-B- 449908	25/05/87	EP-A,A,B 0175858	02/04/86
		JP-C- 1599695	31/01/91
		JP-A- 61082018	25/04/86
		SE-A- 8404813	27/03/86
		US-A- 4705411	10/11/87
CH-A- 606844	15/11/78	DE-A,A- 2613995	21/10/76
		FR-A- 2306431	29/10/76
		JP-A- 51123452	28/10/76
		SE-B,C- 389552	08/11/76
		SE-A- 7503837	04/10/76
		US-A- 4040685	09/08/77
CH-A- 356319	29/09/61	NONE	
FR-A- 423231	11/04/11	NONE	
US-A- 3370900	27/02/68	NONE	